



UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.

684.3077

First Named Inventor or Application Identifier

HIROKI SUZUKAWA

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APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ☒ Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. ☐ Applicant claims small entity status.
See 37 CFR 1.27.
3. ☒ Specification Total Pages
4. ☒ Drawing(s) (35 USC 113) Total Sheets
5. ☐ Oath or Declaration Total Pages
 - a. ☐ Newly executed (original or copy)
 - b. ☐ Copy from a prior application (37 CFR 1.63(d))
(for continuation/divisional with Box 17 completed)
[Note Box 6 below]
 - i. ☐ **DELETION OF INVENTOR(S)**
Signed Statement attached deleting
inventor(s) named in the prior application, see
37 CFR 1.63(d)(2) and 1.33(b).
6. ☒ Application Data Sheet. See 37 CFR 1.76

7. ☐ CD-ROM or CD-R in duplicate, large table or Computer
Program (Appendix)
8. ☐ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
 - a. ☐ Computer Readable Form (CRF)
 - b. Specification Sequence Listing on:
 - i. ☐ CD-ROM or CD-R (2 copies); or
 - ii. ☐ paper
 - c. ☐ Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. ☐ Assignment Papers (cover sheet & document(s))
10. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney
(when there is an assignee)
11. ☐ English Translation Document (if applicable)
12. ☐ Information Disclosure ☐ Copies of IDS
Statement (IDS)/PTO-1449 Citations
13. ☒ Preliminary Amendment
14. ☒ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
15. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
16. ☐ Other: _____

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No. ____/____
Prior application information: Examiner _____ Group/Art Unit: _____

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

18. CORRESPONDENCE ADDRESS

☒ Customer Number or Bar Code Label (Insert Customer No. or Attach bar code label here) or ☐ Correspondence address below

NAME

Address

City

State

Zip Code

Country

Telephone

Fax



CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	30-20 =	10	X \$ 18.00 =	\$ 180.00
	INDEPENDENT CLAIMS (37 CFR 1.16(b))	24-3 =	21	X \$ 78.00 =	\$ 1638.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			\$260.00 =	\$ 0.00
				BASIC FEE (37 CFR 1.16(a))	\$ 690.00
				Total of above Calculations = \$ 2508.00	
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
	TOTAL =				\$ 2508.00

19. Small entity status

- a. ☐ A small entity statement is enclosed
- b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
- c. ☐ Is no longer claimed.


20. ☒ A check in the amount of \$ 2508.00 to cover the filing fee is enclosed.

21. ☐ A check in the amount of \$ _____ to cover the recordal fee is enclosed.

22. The Commissioner is hereby authorized to credit overpayments or charge the following fees to Deposit Account No. 06-1205:

- a. ☒ Fees required under 37 CFR 1.16.
- b. ☐ Fees required under 37 CFR 1.17.
- c. ☐ Fees required under 37 CFR 1.18.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

NAME	Steven E. Warner - Reg. No. 32,326
SIGNATURE	
DATE	September 25, 2000

SEW\cmv

INVENTOR INFORMATION

Inventor One Given Name: Hiroki
Family Name: SUZUKAWA
Postal Address Line One: 4-19-2-601 Motoimaizumi
City of Residence: Utsunomiya-shi
State or Province of Residence: Tochigi-ken
Country of Residence: Japan
Citizenship Country: Japan

CORRESPONDENCE INFORMATION

Correspondence Customer Number: 05514
Fax: (212) 218-2200

APPLICATION INFORMATION

Title Line One: EXPOSURE METHOD AND EXPOSURE APPARATUS

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Application Type: Utility
Docket Number: 684.3077
Secrecy Order in Parent Appl.?: No

REPRESENTATIVE INFORMATION

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PRIOR FOREIGN APPLICATIONS

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Filing Date: 09-24-1999
Country: Japan
Priority Claimed: Yes

684.3077

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
HIROKI SUZUKAWA) : Examiner: UNASSIGNED
Appln. No.: UNASSIGNED) : Group Art Unit: UNASSIGNED
Filed: HERewith) :
For: EXPOSURE METHOD AND EXPOSURE) September 25, 2000
APPARATUS) :

Commissioner for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Prior to examination, please amend the above-identified application as follows.

IN THE SPECIFICATION

Please amend the specification as follows:

Page 2

Line 25, change "Figure 4" to --Figure 4, including Figures 4A and 4B,--.

REMARKS

The specification has been amended to place the application in better form. Applicant requests favorable consideration of the above-referenced application in view of the foregoing amendment.

Applicant's undersigned attorney may be reached in our Washington office by telephone at (202) 530-1010. All correspondence should continue to be directed to our address given below.

Respectfully submitted,



Attorney for Applicant

Registration No. 33,326

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-3801
Facsimile: (212) 218-2200

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EXPOSURE METHOD AND EXPOSURE APPARATUS

FIELD OF THE INVENTION AND RELATED ART

5 This invention relates to an exposure method,
a device manufacturing method and an exposure
apparatus, wherein an exposure process for a substrate
such as a wafer is performed after one or more sample
shot processes are carried out thereto.

10 The wafer processing procedure for producing
"exposed wafers" mainly comprises sample shot
processes such as global tilting for removing any tilt
of a wafer and global alignment for positioning the
wafer, as well as an exposure process. Many attempts
15 have been made to shortening the time required for
each process, to thereby improve the productivity of
"exposed wafers", that is, the throughput.

However, as regards the time for transition
from a certain sample shot process to another sample
shot process or the time for transition from a sample
20 shot process to an exposure process (hereinafter,
"transition time"), no particular attention has been
paid thereto because it is very short as compared with
the time required for each sample shot process itself.

25 SUMMARY OF THE INVENTION

It is an object of the present invention to
enable shortening of such transition time to thereby

increase the throughput.

It is another object of the present invention to provide an exposure method, an exposure apparatus and/or a device manufacturing method by which the transition time is shortened.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a flow chart for explaining the sequence flow of a wafer processing procedure, in an embodiment of the present invention.

Figure 2 is a flow chart for explaining the sequence flow for determining the order of processing sample shots in each sample shot process to be done in relation to the wafer processing procedure of Figure 1 and to be made to a wafer having a shot layout such as shown in Figure 3.

Figure 3 is a schematic view of an example of a wafer shot layout, to be processed in relation to the flow chart of Figure 2.

Figure 4 is a flow chart for explaining the sequence flow for determining the positions of and the

order of processing sample shots in each sample shot process to be done in relation to the wafer processing procedure of Figure 1 and to be made to a wafer having a shot layout such as shown in Figure 5.

5 Figure 5 is a schematic view of an example of a wafer shot layout, to be processed in relation to the flow chart of Figure 4.

10 Figure 6 is a flow chart for explaining the sequence flow for determining the order of processing sample shots in each sample shot process and the order of processing exposure shots in an exposure process which are to be done in relation to the wafer processing procedure of Figure 1 and to be made to a wafer having a shot layout such as shown in Figure 7.

15 Figure 7 is a schematic view of an example of a wafer shot layout, to be processed in relation to the flow chart of Figure 6.

20 Figures 8A - 8D are schematic views, respectively, for explaining examples of a first processing shot in an exposure process and the order of processing the remaining shots in that process, as determined in accordance with the sequence flow of Figure 6 example.

25 Figure 9 is a flow chart of microdevice manufacturing processes.

 Figure 10 is a flow chart for explaining details of a wafer process included in the procedure

of Figure 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present
5 invention will now be described with reference to the
accompanying drawings. Briefly, in these embodiments,
the order of processing sample shots, the positions of
sample shots, the processing order in an exposure
process and the like may be determined so as to
10 shorten the distance between the last shot in a
certain sample shot process and the first shot in a
subsequent sample shot process and/or the distance
between the last shot in a certain sample shot process
and the first shot in a subsequent exposure process
15 (hereinafter, "transition distance"). This
effectively shorten the movement time for a stage
which moves through the transition distance.

Figure 1 shows a sequence flow of a wafer
processing procedure in an embodiment of the present
20 invention. As shown in the drawing, as the wafer
processing procedure starts, sample shot processes of
prealignment (step S11), global tilting (step S12) and
global alignment (step S13) are made to a wafer placed
on a wafer stage, in the named order. Then, finally,
25 an exposure process is carried out (step S14).

As regards the prealignment process, the
wafer stage is moved to each sample shot, and the

position of a prealignment mark or marks there is measured. On the basis of the results of measurements, the wafer is roughly positioned. In the global tilting process, the wafer stage is moved to each sample shot, and the focus thereat is measured. On the basis of the results of measurements, any tilt of the wafer is removed so that the surface of the wafer to be exposed is placed horizontally. Then, in the global alignment process, the wafer stage is moved to each sample shot, and the position of an alignment mark or marks there is measured. On the basis of the results of measurements, the wafer is positioned precisely. After the precise positioning, the wafer stage is moved to each shot, and exposures of these shots are performed.

There is a transition time from a certain sample shot process to another sample shot process, or from a certain sample shot process to an exposure process. Also, there is a transition distance from the last shot in a certain sample shot process to the first shot in a subsequent sample shot process or from the last shot in a certain sample shot process to the first shot of an exposure process. In some examples to be described below, the order of processing sample shots, the position of each sample shot, and/or the order of processing shots in an exposure process is determined so as to reduce the transition distance

described above, thereby to reduce the movement time of a stage which moves through the transition distance. In this manner, the transition time described above can be shortened.

5

[Example of Determining Sample Shot Processing Order]

Figure 2 shows a sequence flow for determining the order of processing sample shots in each sample shot process to be made to a wafer having a shot layout such as shown in Figure 3. The number of sample shots and positions of them in each sample shot process as well as the shot layout in an exposure process are selectable. Figure 3 shows an example of selection. In Figure 3, Pa and Pb denote sample shots for prealignment (two shots in this example), Ta - Td denote sample shots for global tilting (four shots in this example), and Aa - Ad are sample shots for global alignment (four shots in this example). Numbers 1 - 32 denote exposure shot Nos., and the exposure shots No.1 - No.32 are to be exposed in this numerical order.

As the sequence starts, first, one of the sample shots Aa - Ad which is closest to the exposure shot No.1 is determined by calculation on the basis of the X-Y coordinate positions of them (step S21). More specifically, where the X-Y coordinate of the exposure shot No.1 is (X_1, Y_1) while the X-Y coordinates of the

sample shots Aa - Ad are (Xa, Ya), (Xb, Yb), (Xc, Yc) and (Xd, Yd), respectively, the distances Da - Dd of the sample shots Aa - Ad from the exposure shot No.1 are given by the following equations.

5

$$Da = \sqrt{[(Xa-X_1)^2 + (Ya-Y_1)^2]}$$

$$Db = \sqrt{[(Xb-X_1)^2 + (Yb-Y_1)^2]}$$

$$Dc = \sqrt{[(Xc-X_1)^2 + (Yc-Y_1)^2]}$$

10

$$Dd = \sqrt{[(Xd-X_1)^2 + (Yd-Y_1)^2]}$$

Thus, the one shot which corresponds to the smallest one of Da - Dd is detected. In this example, the sample shot Ac is determined so.

15 Next, the processing order for the sample shots Aa - Ad is so determined that the thus detected shot is taken as the last shot. The first shot to be processed first is named as shot A₁ (step S22). Here, in this example, in the sample shot process, the

20 processing is going to be made to the sample shots counterclockwise. However, any other rule may be used in place of the counterclockwise processing. In this example, therefore, the sample shots will be

25 processed in an order of Ad, Aa, Ab and Ac. The first shot A₁ for the global alignment process is the sample shot Ad.

 The above-described procedure for determining

a shot closest to a particular shot, by calculation on the basis of X-Y coordinate position thereof, can be applied to any other case to be described below. Details of the procedure will therefore be omitted in
5 the following description.

Subsequently, in a similar manner, one of the sample shots Ta - Td for the global tilting process which is closest to a first processing shot A₁ (Ad) in the global alignment process, is determined by
10 calculation on the basis of the X-Y coordinate positions of them (step S23). In this example, the sample shot Td is detected so. Then, the processing order for the sample shots Ta - Td is so determined that the thus detected shot is taken as the last shot.
15 A first shot to be processed first is named as T₁ (step S24). Thus, in this example, the sample shots will be processed in an order of Ta, Tb, Tc and Td. The first processing shot T₁ in the global tilting process is the sample shot Ta.

20 Subsequently, one of the sample shots Pa and Pb for the prealignment process which is closest to the first processing shot T₁ (Ta) in the global tilting process is determined by calculation on the basis of the X-Y coordinate positions of them (step
25 S25). In this example, the sample shot Pa is determined so. Then, the processing order for the sample shots Pa and Pb is so determined that the thus

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detected shot is taken as the last shot. The first shot to be processed first is named P_1 (step S26). Thus, in this example, the sample shots Pa and Pb will be processed in an order of Pb and Pa. The first shot P_1 to be processed first in the prealignment process is the sample shot Pb.

With the procedure described above, all the sample shot processing orders in every sample shot process are determined.

[Example of Determining Sample Shot Position and Sample Shot Processing Order]

Figure 4 shows a sequence flow for determining the order of processing sample shots in each sample shot process to be made to a wafer having a shot layout such as shown in Figure 4. The number of sample shots in each sample shot process as well as the shot layout in an exposure process are selectable. In this example, the selection may be made to be described below. However, in this example, the number of sample shots for the prealignment process is fixed to two. More specifically, the number of sample shots for prealignment is two (fixed), the number of sample shots for global tilting is four, and the number of sample shots for global alignment is four.

As the sequence flow of Figure 4 starts, first, shot options to be chosen as sample shots for

global alignment are selected (step S41). In this example, for better correction precision to wafer magnification and wafer rotation, a condition that the options should be those shots located at the

5 outermost periphery of the shot layout is set. Thus, in this example, the options are those shots marked with painted circles in Figure 5, that is, the shots with exposure shot Nos. 1, 2, 3, 4, 5, 10, 11, 16, 17, 22, 23, 28, 29, 30, 31 and 32. However, any other

10 rule may be used for selection of options.

Subsequently, among these shot options, one which is closest to the exposure shot No.1 is detected by calculation on the basis of the X-Y coordinate positions of them (step S42). In this example, the

15 exposure shot No. 1 is determined so. Then, the positions of sample shots as well as the processing order of them are so determined that the thus detected sample shot is taken as the last shot. The first shot to be processed first is named shot A_1 (step S43). In

20 this example, in the sample shot processes, the sample shots are processed in a counterclockwise order, and also these sample shots are placed equidistantly. However, any other rule may be used in place of the above. In this example, therefore, first, a shot A_4

25 (exposure shot No.1) is selected as a sample shot and, then, the remaining sample shots $A_2 - A_4$ are so selected that all the sample shots will be processed

in an order of A_1 , A_2 , A_3 and A_4 and also that these sample shots are placed equidistantly. Thus, the first shot A_1 to be processed first in the global alignment process is exposure shot No.23.

5 Subsequently, in a similar manner, shot options to be chosen for sample shots in the global tilting process are selected (step S44). In this example, for better correction precision to wafer tilting and for avoiding the influence of a warp of
10 the wafer outer peripheral portion, a condition that the options should be those shots each being next (inwardly adjoining) to an outermost peripheral shot in the shot layout is set. However, any other rule may be used. In this example, therefore, shot options
15 are those shots marked with non-painted circles in Figure 5, that is, the shots with exposure shot Nos. 6, 7, 8, 9, 12, 15, 18, 21, 24, 25, 26 and 27. Next, among these shot options, one which is closest to the first processing shot A_1 to be processed first in the
20 global alignment process is detected by calculation on the basis of the X-Y coordinate positions of them (step S45). In this example, a shot with exposure shot No.24 is detected so. Subsequently, the positions of sample shots as well as the processing
25 order for them are determined so that the thus detected shot is taken as the last shot. The first shot to be processed first is named shot T_1 (step

S46). In this example, in the sample shot process, the sample shots are processed in a counterclockwise order, and also the selection is made so that these sample shots are placed equidistantly. However, any other rule may be used in place of the above. In this example, therefore, first, a shot T_4 (exposure shot No.24) is selected as a sample shot and, then, the remaining sample shots $T_2 - T_4$ are so selected that all the sample shots will be processed in an order of T_1, T_2, T_3 and T_4 and also that these sample shots are placed equidistantly. Thus, the first shot T_1 to be processed first in the global tilting process is exposure shot No.27.

Subsequently, shot options to be chosen for sample shots in the prealignment process are selected (step S47). In this example, for better correction precision to wafer rotation, a condition that the options should be those shots each being located at the outermost periphery of the shot layout and being present on a straight line passing through the center of the shot layout and extending in parallel to the X axis, is set. However, any other rule may be used. In this example, therefore, shot options are those shots marked with triangles in Figure 5, that is, the shots with exposure shot Nos. 11, 16, 17 and 22. Next, among these shot options, one which is closest to the first processing shot T_1 to be processed first

in the global tilting process is detected by calculation on the basis of the X-Y coordinate positions of them (step S48). In this example, a shot with exposure shot No.17 is detected so.

5 Subsequently, the positions of sample shots
as well as the processing order for them are
determined so that the thus detected shot is taken as
the last shot. The first shot to be processed first
is named shot P_1 (step S49). In this example, the
10 number of sample shots for prealignment is fixed to
two, and these two shots should be placed in a
symmetrical relation with each other with respect to
the wafer center. However, any other rule may be
used. In this example, therefore, first, a shot P_2
15 (exposure shot No.17) is selected as a sample shot
and, thereafter, another sample shot P_1 is selected so
that these shots will be processed in an order of P_1
and P_2 . Thus, the first processing shot P_1 to be
processed first in the prealignment process is the
20 shot with exposure shot No.11.

With the procedure described above, the
positions of all the sample shots as well as the
sample shot processing orders in every sample shot
process are determined.

25

[Example of Determining Processing Order of Sample

Shots and Exposure Shots]

Figure 6 shows a sequence flow for determining the order of processing sample shots in each sample shot process as well as the order of processing exposure shots in an exposure process which are to be made to a wafer having a shot layout such as shown in Figure 7. The number of sample shots and positions of them in each sample shot process as well as the shot layout in the exposure process are selectable. Figure 7 shows an example of selection. Here, it is assumed that the processing order for sample shots in the prealignment process is already determined as an order Pa and Pb, and that the exposure order is not yet determined. In Figure 7, Pa and Pb denote sample shots for prealignment (two shots in this example), Ta - Td denote sample shots for global tilting (four shots in this example), and Aa - Ad are sample shots for global alignment (four shots in this example). Also, Ea - Ed denoted shot options for a first processing shot to be processed first in the exposure process. Numbers 1 - 32 denote exposure shot Nos. The order of exposure shots is determined in accordance with the first processing shot. In this example, the shot options to be chosen for the first processing shot in the exposure process should be those shots which are located at the opposite ends of the top or bottom array (row) of the shot layout, that

is, shots Ea - Ed. Also, when any one of these shots is selected as the first processing shot, the processing order will be determined in a manner as shown in corresponding one of Figures 8A - 8D.

5 However, any other rule may be used.

The processing order in the prealignment process is in the order of Pa and Pb, as described above. Thus, as the sequence starts, first, one of the sample shots Ta - Td which is closest to the Pb is
10 determined by calculation on the basis of the X-Y coordinate positions of them (step S61). In this example, the sample shot Td is determined so. Subsequently, the processing order for the sample shots Ta - Td is so determined that the thus detected
15 shot is taken as the first shot. The last shot to be processed last is named as shot T₄ (step S62). Here, in this example, in the sample shot process, the processing is going to be made to the sample shots counterclockwise. However, any other rule may be used
20 in place of the counterclockwise processing. In this example, therefore, the sample shots will be processed in an order of Td, Ta, Tb and Tc. The first last T₄ for the global tilting process is the sample shot Tc.

Subsequently, in a similar manner, one of the
25 sample shots Aa - Ad which is closest to the shot T₄ (shot Tc) is determined by calculation on the basis of the X-Y coordinate positions of them (step S63). In

this example, the sample shot Ac is detected so.

Then, the processing order for the sample shots Aa -

Ad is so determined that the thus detected shot is taken as the first processing shot to be processed

5 first. The last shot to be processed last is named as A₄ (step S64). Thus, in this example, the sample shots will be processed in an order of Ac, Ad, Aa and Ab. The last shot A₄ in the global alignment process is the sample shot Ab.

10 Subsequently, among the shots Ea - Eb, one which is closest to the shot A₄ (shot Ab) is detected by calculation on the basis of the X-Y coordinate positions of them (step S65). In this example, the shot Eb is determined so. Thus, the first processing
15 shot to be processed first in the exposure process is the shot Eb. Also, the order of exposure process corresponding to this is determined such as shown in Figure 8B (step S66).

20 With the procedure described above, the order of processing sample shots in each sample shot process as well as the order of processing exposure shots in the exposure process are determined.

[Embodiment of Device Manufacturing Method]

25 Next, an embodiment of a semiconductor device manufacturing method which uses an exposure method according to any one of the preceding examples, will

be explained.

Figure 9 is a flow chart of procedure for manufacture of microdevices such as semiconductor chips (e.g. ICs or LSIs), liquid crystal panels, CCDs, thin film magnetic heads or micro-machines, for example.

Step 1 is a design process for designing a circuit of a semiconductor device. Step 2 is a process for making a mask on the basis of the circuit pattern design. Step 3 is a process for preparing a wafer by using a material such as silicon. Step 4 is a wafer process (called a pre-process) wherein, by using the so prepared mask and wafer, circuits are practically formed on the wafer through lithography. Step 5 subsequent to this is an assembling step (called a post-process) wherein the wafer having been processed by step 4 is formed into semiconductor chips. This step includes an assembling (dicing and bonding) process and a packaging (chip sealing) process. Step 6 is an inspection step wherein operation check, durability check and so on for the semiconductor devices provided by step 5, are carried out. With these processes, semiconductor devices are completed and they are shipped (step 7).

Figure 10 is a flow chart showing details of the wafer process.

Step 11 is an oxidation process for oxidizing

the surface of a wafer. Step 12 is a CVD process for forming an insulating film on the wafer surface. Step 13 is an electrode forming process for forming electrodes upon the wafer by vapor deposition. Step 14 is an ion implanting process for implanting ions to the wafer. Step 15 is a resist process for applying a resist (photosensitive material) to the wafer. Step 16 is an exposure process for printing, by exposure, the circuit pattern of the mask on the wafer through the exposure apparatus described above. Step 17 is a developing process for developing the exposed wafer. Step 18 is an etching process for removing portions other than the developed resist image. Step 19 is a resist separation process for separating the resist material remaining on the wafer after being subjected to the etching process. By repeating these processes, circuit patterns are superposedly formed on the wafer.

With these processes, high density microdevices can be manufactured, with a higher productivity.

In accordance with the embodiments of the present invention as described hereinbefore, the transition distance which corresponds to the distance between the last shot in a certain sample shot process and the first shot in a subsequent sample shot process or the distance between the last shot in a certain sample shot process and the first shot in a subsequent

exposure process, can be shortened significantly.

Therefore, the movement time of a stage which moves through the transition distance can be shortened significantly. As a result, a processing time per a single substrate to be exposed can be reduced effectively, and also the productivity of "exposed wafers", that is, the throughput, can be improved significantly.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

WHAT IS CLAIMED IS:

1/ An exposure method including plural sample
shot processes to be made to a substrate and an
exposure process to be made to the substrate after
5 completion of the sample shot processes, said method
comprising:

a first determining step for determining the
processing order in a first sample shot process, of
the plural sample shot processes; and

10 a second determining step for determining the
processing order in a second sample shot process to be
made after the first sample shot process;

wherein, in at least one of the first and
second determining steps, the determination is made
15 under a condition that an interval between a shot to
be processed last in the first sample shot process and
a shot to be processed first in the second sample shot
process is shortened.

20 2. A method according to Claim 1, wherein, in
said at least one determining step, positions of
sample shots are also determined.

3. An exposure method including a sample shot
25 process to be made to a substrate and an exposure
process to be made to the substrate after completion
of the sample shot process, said method comprising:

a first determining step for determining the processing order in the sample shot process; and

a second determining step for determining the processing order in the exposure process to be made
5 after the sample shot process;

wherein, in at least one of the first and second determining steps, the determination is made under a condition that an interval between a shot to be processed last in the sample shot process and a
10 shot to be processed first in the exposure process is shortened.

4. A method according to Claim 3, wherein, in said at least one determining step, positions of
15 sample shots are also determined.

5. An exposure method including plural sample shot processes to be made to a substrate and an exposure process to be made to the substrate after
20 completion of the sample shot processes, said method comprising:

a first determining step for determining the processing order in a first sample shot process, of the plural sample shot processes; and

25 a second determining step for determining the processing order in a second sample shot process to be made after the first sample shot process, in

accordance with a position of a shot to be processed last in the first sample shot process.

6. An exposure method including plural sample shot processes to be made to a substrate and an exposure process to be made to the substrate after completion of the sample shot processes, said method comprising:

a first determining step for determining the processing order in a first sample shot process, of the plural sample shot processes; and

a second determining step for determining the processing order in a second sample shot process to be made prior to the first sample shot process, on the basis of a position of a shot to be processed first in the first sample shot process.

7. An exposure method including a sample shot process to be made to a substrate and an exposure process to be made to the substrate after completion of the sample shot process, said method comprising:

a first determining step for determining the processing order in the sample shot process; and

a second determining step for determining the processing order in the exposure process to be made after the sample shot process, in accordance with a position of a shot to be processed last in the sample

shot process.

8. An exposure method including a sample shot process to be made to a substrate and an exposure process to be made to the substrate after completion of the sample shot process, said method comprising:

a first determining step for determining the processing order in the exposure process; and

a second determining step for determining the processing order in the sample shot process to be made prior to the exposure process, in accordance with a position of a shot to be processed first in the exposure process.

9. An exposure method including plural sample shot processes to be made to a substrate and an exposure process to be made to the substrate after completion of the sample shot processes, said method comprising:

a first determining step for determining the processing order in a first sample shot process, of the plural sample shot processes; and

a second determining step for determining the processing order in a second sample shot process to be made after the first sample shot process;

wherein, in at least one of the first and second determining steps, the determination is made so

that a difference between a position of a shot to be processed last in the first sample shot process and a position of a shot to be processed first in the second sample shot process is placed within a range of a single shot with respect to a vertical and longitudinal size in a shot layout.

10. An exposure method including a sample shot process to be made to a substrate and an exposure process to be made to the substrate after completion of the sample shot process, said method comprising:

a first determining step for determining the processing order in the sample shot process; and

a second determining step for determining the processing order in the exposure process to be made after the sample shot process;

wherein, in at least one of the first and second determining steps, the determination is made so that a difference between a position of a shot to be processed last in the sample shot process and a position of a shot to be processed first in the exposure process is placed within a range of a single shot with respect to a vertical and longitudinal size in a shot layout.

11. A device manufacturing method, comprising:
an exposure step including plural sample shot

processes to be made to a substrate and an exposure
process to be made to the substrate after completion
of the sample shot processes, said exposure step
further including (i) a first determining step for
5 determining the processing order in a first sample
shot process, of the plural sample shot processes, and
(ii) a second determining step for determining the
processing order in a second sample shot process to be
made after the first sample shot process, wherein, in
10 at least one of the first and second determining
steps, the determination is made under a condition
that an interval between a shot to be processed last
in the first sample shot process and a shot to be
processed first in the second sample shot process is
15 shortened; and

a developing step for performing a
development process to the substrate having been
processed at said exposure step, for production of
devices on the substrate.

20

12. A method according to Claim 11, wherein, in
said at least one determining step, positions of
sample shots are also determined.

25

13. A device manufacturing method, comprising:
an exposure step including a sample shot
process to be made to a substrate and an exposure

process to be made to the substrate after completion of the sample shot process, said exposure step further including (i) a first determining step for determining the processing order in the sample shot process, and
5 (ii) a second determining step for determining the processing order in the exposure process to be made after the sample shot process, wherein, in at least one of the first and second determining steps, the determination is made under a condition that an
10 interval between a shot to be processed last in the sample shot process and a shot to be processed first in the exposure process is shortened; and

a developing step for performing a development process to the substrate having been
15 processed at said exposure step, for production of devices on the substrate.

14. A method according to Claim 13, wherein, in said at least one determining step, positions of
20 sample shots are also determined.

15. A device manufacturing method, comprising:
an exposure step including plural sample shot processes to be made to a substrate and an exposure
25 process to be made to the substrate after completion of the sample shot processes, said exposure step further including (i) a first determining step for

determining the processing order in a first sample
shot process, of the plural sample shot processes, and
(ii) a second determining step for determining the
processing order in a second sample shot process to be
5 made after the first sample shot process, in
accordance with a position of a shot to be processed
last in the first sample shot process; and

a developing step for performing a
development process to the substrate having been
10 processed at said exposure step, for production of
devices on the substrate.

16. A device manufacturing method, comprising:
an exposure step including plural sample shot
15 processes to be made to a substrate and an exposure
process to be made to the substrate after completion
of the sample shot processes, said exposure step
further including (i) a first determining step for
determining the processing order in a first sample
20 shot process, of the plural sample shot processes, and
(ii) a second determining step for determining the
processing order in a second sample shot process to be
made prior to the first sample shot process, on the
basis of a position of a shot to be processed first in
25 the first sample shot process; and

a developing step for performing a
development process to the substrate having been

processed at said exposure step, for production of devices on the substrate.

17. A device manufacturing method, comprising:

5 an exposure step including a sample shot process to be made to a substrate and an exposure process to be made to the substrate after completion of the sample shot process, said exposure step further including (i) a first determining step for determining
10 the processing order in the sample shot process, and (ii) a second determining step for determining the processing order in the exposure process to be made after the sample shot process, in accordance with a position of a shot to be processed last in the sample
15 shot process; and

a developing step for performing a development process to the substrate having been processed at said exposure step, for production of devices on the substrate.

18. A device manufacturing method, comprising:

20 an exposure step including a sample shot process to be made to a substrate and an exposure process to be made to the substrate after completion
25 of the sample shot process, said exposure step further including (i) a first determining step for determining the processing order in the exposure process, and (ii)

a second determining step for determining the processing order in the sample shot process to be made prior to the exposure process, in accordance with a position of a shot to be processed first in the exposure process; and

a developing step for performing a development process to the substrate having been processed at said exposure step, for production of devices on the substrate.

19. A device manufacturing method, comprising:

an exposure step including plural sample shot processes to be made to a substrate and an exposure process to be made to the substrate after completion of the sample shot processes, said exposure step further including (i) a first determining step for determining the processing order in a first sample shot process, of the plural sample shot processes, and (ii) a second determining step for determining the processing order in a second sample shot process to be made after the first sample shot process, wherein, in at least one of the first and second determining steps, the determination is made so that a difference between a position of a shot to be processed last in the first sample shot process and a position of a shot to be processed first in the second sample shot process is placed within a range of a single shot with

respect to a vertical and longitudinal size in a shot layout; and

5 a developing step for performing a development process to the substrate having been processed at said exposure step, for production of devices on the substrate.

20. A device manufacturing method, comprising:
an exposure step including a sample shot
10 process to be made to a substrate and an exposure process to be made to the substrate after completion of the sample shot process, said exposure step further including (i) a first determining step for determining the processing order in the sample shot process, and
15 (ii) a second determining step for determining the processing order in the exposure process to be made after the sample shot process, wherein, in at least one of the first and second determining steps, the determination is made so that a difference between a
20 position of a shot to be processed last in the sample shot process and a position of a shot to be processed first in the exposure process is placed within a range of a single shot with respect to a vertical and longitudinal size in a shot layout; and

25 a developing step for performing a development process to the substrate having been processed at said exposure step, for production of

devices on the substrate.

21. An exposure apparatus wherein plural sample
shot processes are made to a substrate and an exposure
5 process is made to the substrate after completion of
the sample shot processes, said apparatus comprising:

first determining means for determining the
processing order in a first sample shot process, of
the plural sample shot processes; and

10 second determining means for determining the
processing order in a second sample shot process to be
made after the first sample shot process;

wherein, in at least one of said first and
second determining means, the determination is made
15 under a condition that an interval between a shot to
be processed last in the first sample shot process and
a shot to be processed first in the second sample shot
process is shortened.

20 22. An apparatus according to Claim 21, wherein,
in said at least one determining means, positions of
sample shots are also determined.

23. An exposure apparatus wherein a sample shot
25 process is made to a substrate and an exposure process
is made to the substrate after completion of the
sample shot process, said apparatus comprising:

first determining means for determining the processing order in the sample shot process; and

second determining means for determining the processing order in the exposure process to be made after the sample shot process;

wherein, in at least one of the first and second determining means, the determination is made under a condition that an interval between a shot to be processed last in the sample shot process and a shot to be processed first in the exposure process is shortened.

24. An apparatus according to Claim 23, wherein, in said at least one determining means, positions of sample shots are also determined.

25. An exposure apparatus wherein plural sample shot processes are made to a substrate and an exposure process is made to the substrate after completion of the sample shot processes, said apparatus comprising:

first determining means for determining the processing order in a first sample shot process, of the plural sample shot processes; and

second determining means for determining the processing order in a second sample shot process to be made after the first sample shot process, in accordance with a position of a shot to be processed

last in the first sample shot process.

26. An exposure apparatus wherein plural sample shot processes are made to a substrate and an exposure process is made to the substrate after completion of the sample shot processes, said apparatus comprising:

first determining means for determining the processing order in a first sample shot process, of the plural sample shot processes; and

second determining means for determining the processing order in a second sample shot process to be made prior to the first sample shot process, on the basis of a position of a shot to be processed first in the first sample shot process.

27. An exposure apparatus wherein a sample shot process is made to a substrate and an exposure process is made to the substrate after completion of the sample shot process, said apparatus comprising:

first determining means for determining the processing order in the sample shot process; and

second determining means for determining the processing order in the exposure process to be made after the sample shot process, in accordance with a position of a shot to be processed last in the sample shot process.

5 first determining means for determining the
processing order in the exposure process; and

10

15

20

25

wherein, in at least one of the first and second determining means, the determination is made so that a difference between a position of a shot to be processed last in the first sample shot process and a position of a shot to be processed first in the second

sample shot process is placed within a range of a single shot with respect to a vertical and longitudinal size in a shot layout.

5 30. An exposure apparatus wherein a sample shot process is made to a substrate and an exposure process is made to the substrate after completion of the sample shot process, said apparatus comprising:

10 first determining means for determining the processing order in the sample shot process; and

 second determining means for determining the processing order in the exposure process to be made after the sample shot process;

15 wherein, in at least one of the first and second determining means, the determination is made so that a difference between a position of a shot to be processed last in the sample shot process and a position of a shot to be processed first in the exposure process is placed within a range of a single
20 shot with respect to a vertical and longitudinal size in a shot layout.

An exposure method and an exposure apparatus are disclosed wherein one or more plural sample shot processes are made to a substrate and an exposure

25

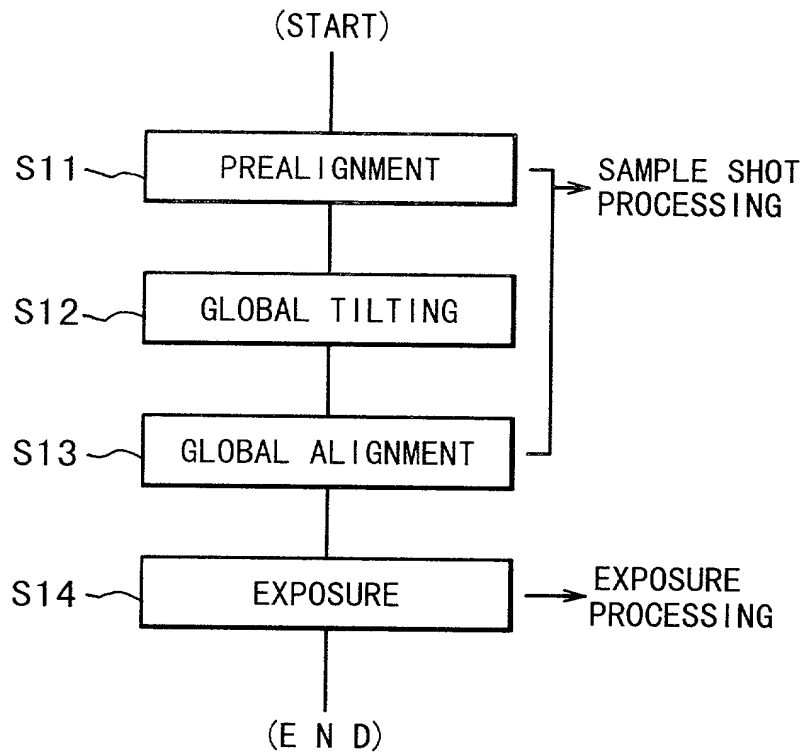


FIG. 1

Pa, Pb : SAMPLE SHOTS FOR PREALIGNMENT
 Ta—Td: SAMPLE SHOTS FOR GLOBAL TILTING
 Aa—Ad: SAMPLE SHOTS FOR GLOBAL ALIGNMENT
 1—32 : EXPOSURE SHOTS (TO BE EXPOSED IN
 NUMERICAL ORDER)

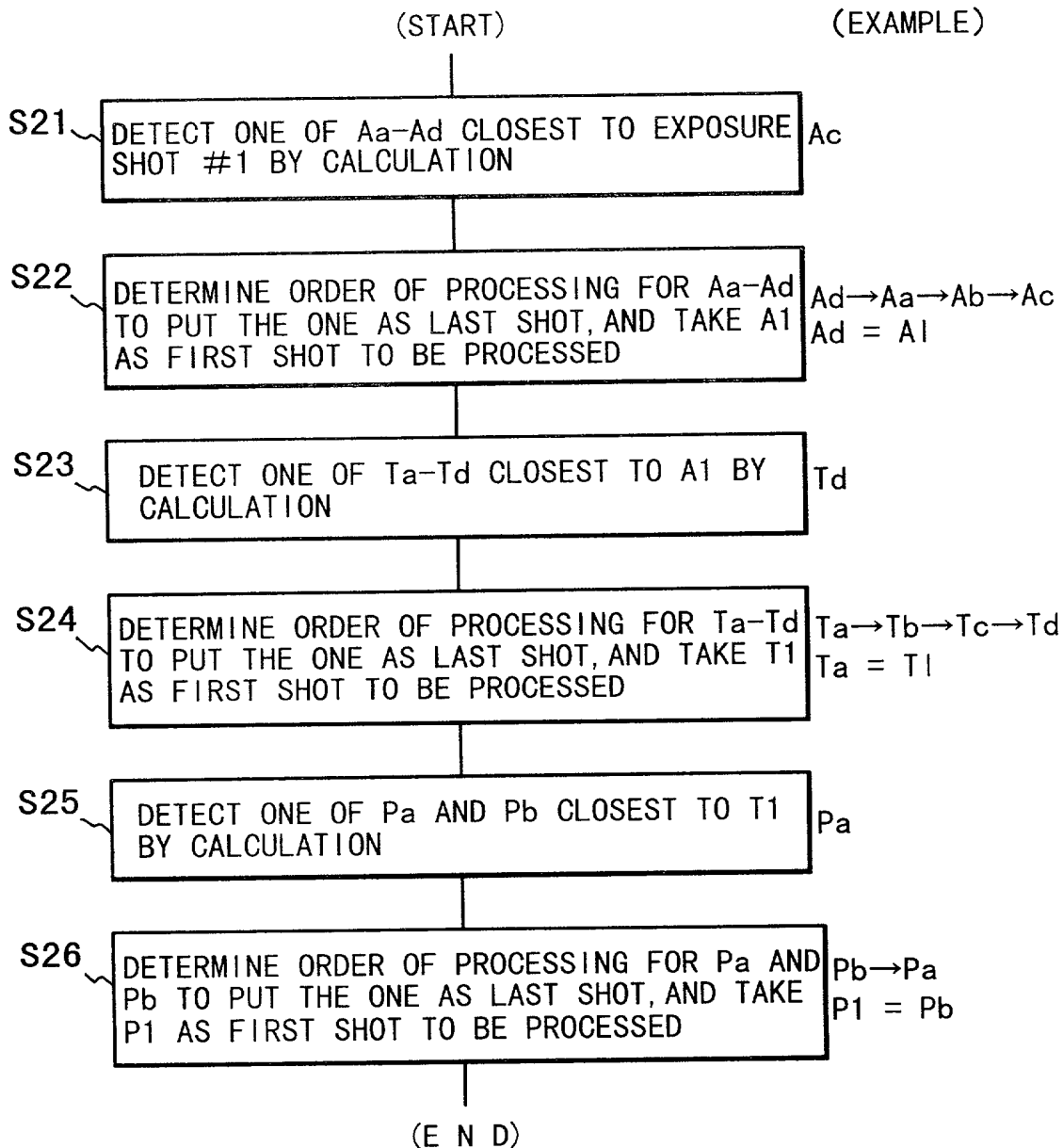


FIG. 2

	29	30	31	32	
28	Aa 27	Ta 26	25	Ad 24	23
17	Pa 18	19	20	Td 21	22
16	Tb 15	14	13	Pb 12	11
5	Ab 6	7	Tc 8	Ac 9	10
	4	3	2	1	

FIG. 3

P1, P2 : SAMPLE SHOTS FOR PREALIGNMENT
 T1 - T4: SAMPLE SHOTS FOR GLOBAL TILTING
 A1 - A4: SAMPLE SHOTS FOR GLOBAL ALIGNMENT
 1-32 : EXPOSURE SHOTS (TO BE EXPOSED IN
 NUMERICAL ORDER)

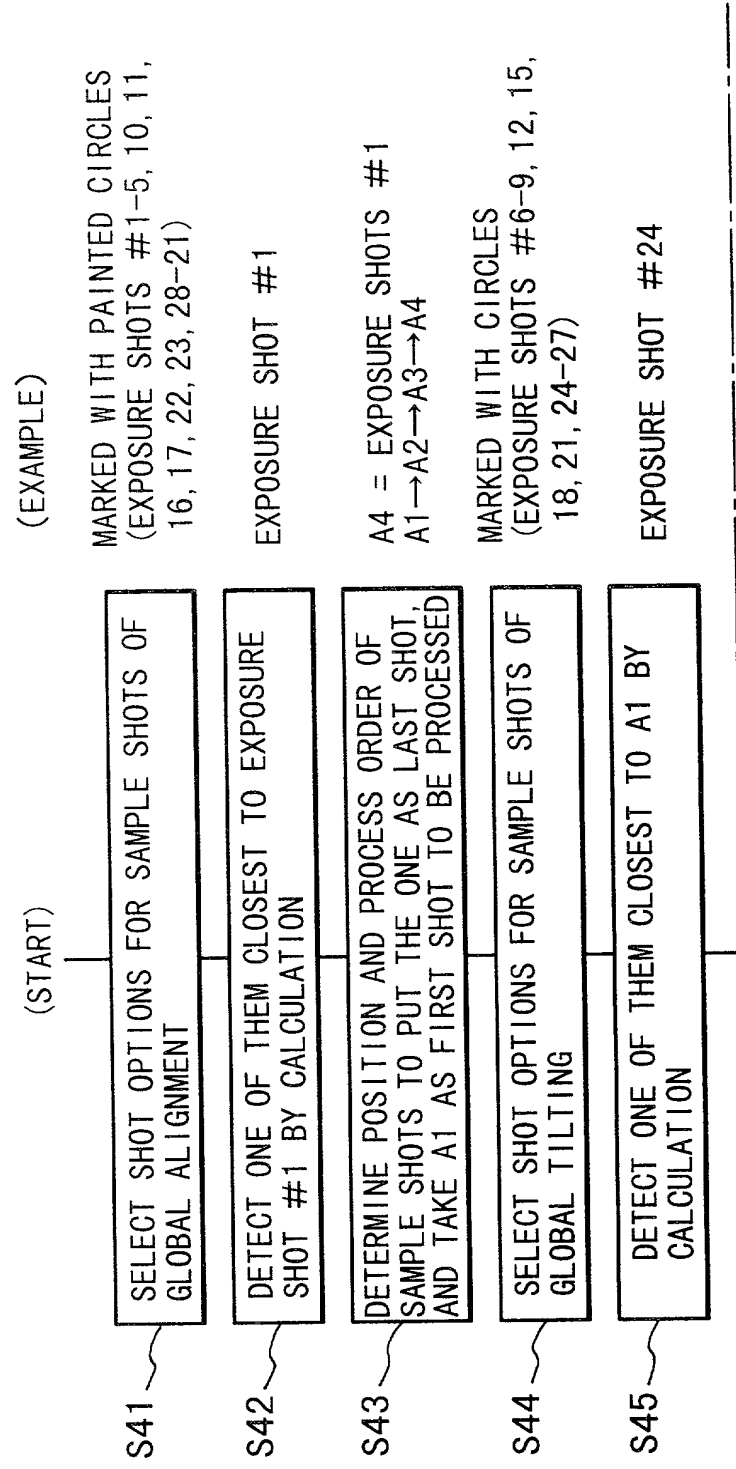


FIG. 4A

S46 DETERMINE POSITION AND PROCESS ORDER OF
SAMPLE SHOTS TO PUT THE ONE AS LAST SHOT,
AND TAKE T1 AS FIRST SHOT TO BE PROCESSED

T4 = EXPOSURE SHOT #24
T1→T2→T3→T4

S47 SELECT SHOT OPTIONS FOR SAMPLE SHOTS OF
PREALIGNMENT

MARKED WITH TRIANGLES
(EXPOSURE SHOTS #11, 16, 17, 22)

S48 DETECT ONE OF THEM CLOSEST TO T1 BY
CALCULATION

EXPOSURE SHOT #17

S49 DETERMINE POSITION AND PROCESS ORDER OF
SAMPLE SHOTS TO PUT THE ONE AS LAST SHOT,
AND TAKE P1 AS FIRST SHOT TO BE PROCESSED

P2 = EXPOSURE SHOT #17
P1→P2

(E N D)

FIG. 4B

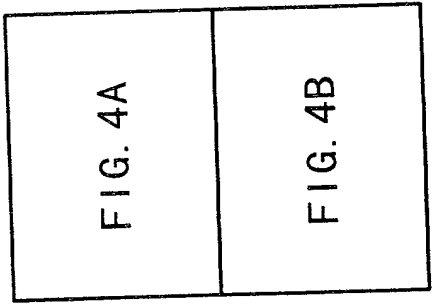


FIG. 4

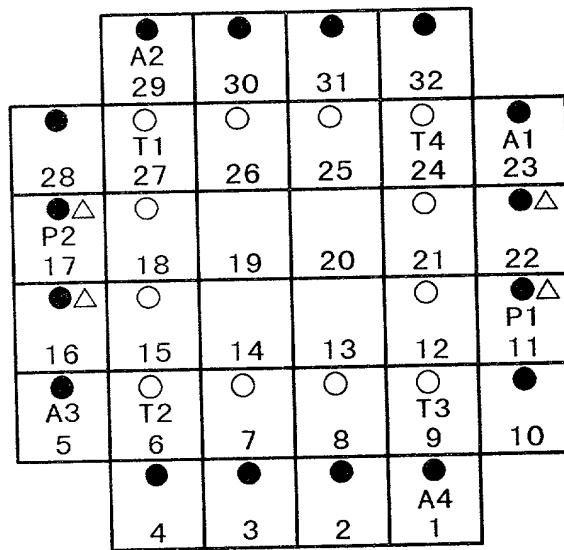


FIG. 5

Pa, Pb: SAMPLE SHOTS FOR PREALIGNMENT
 Ta-Td: SAMPLE SHOTS FOR GLOBAL TILTING
 Aa-Ad: SAMPLE SHOTS FOR GLOBAL ALIGNMENT
 Ea-Ed: OPTIONS FOR SHOT TO BE PROCESSED
 FIRST IN EXPOSURE PROCESSING
 1-32 : EXPOSURE SHOTS (TO BE EXPOSED IN
 NUMERICAL ORDER)

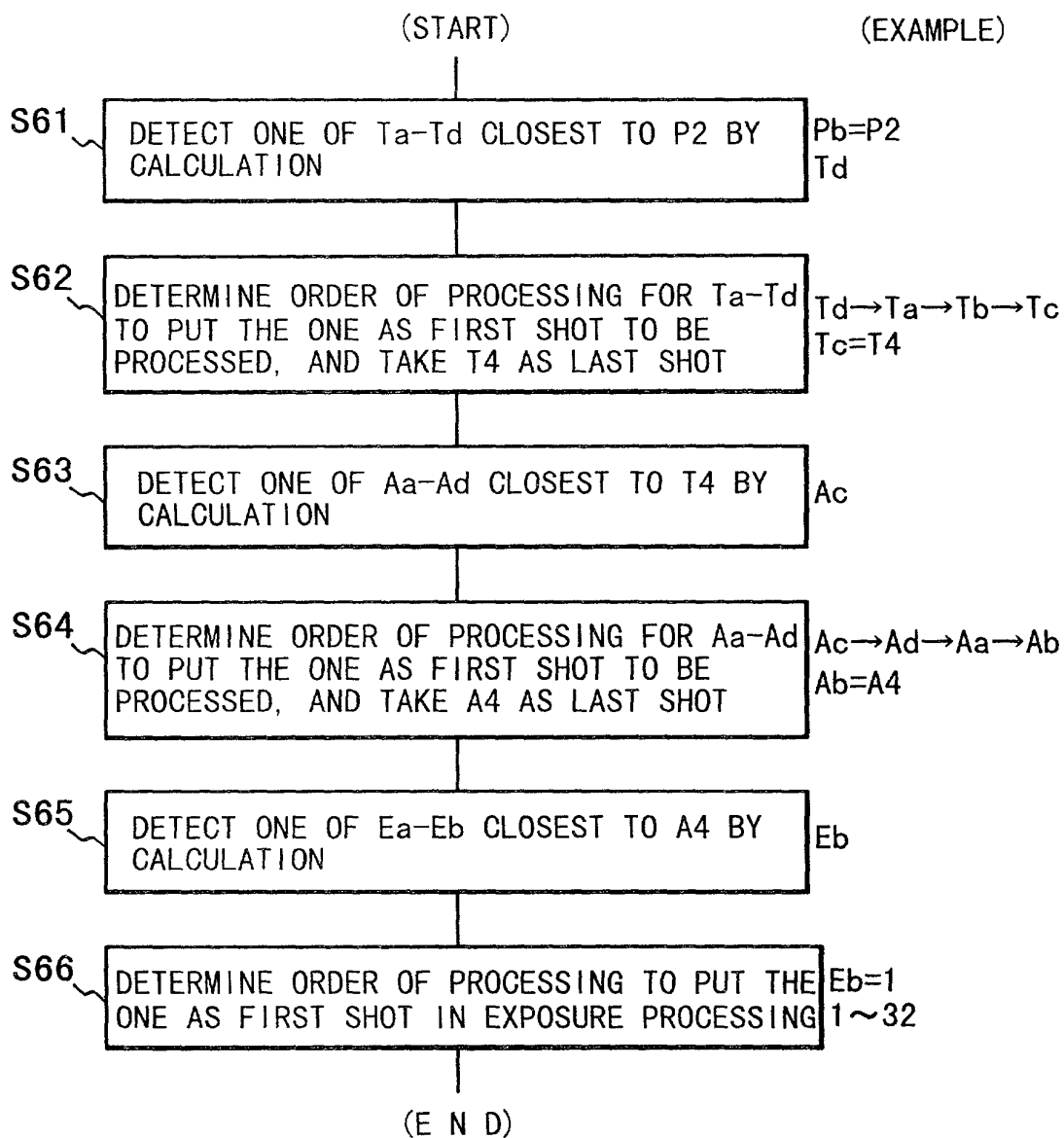


FIG. 6

	Ea 32	31	30	Ed 29	
23	Aa 24	Ta 25	26	Ad 27	28
22	Pa 21	20	19	Td 18	17
11	Tb 12	13	14	Pb 15	16
10	Ab 9	8	Tc 7	Ac 6	5
	Eb 1	2	3	Ec 4	

FIG. 7

START FROM Ea

	1	2	3	4	
10	9	8	7	6	5
11	12	13	14	15	16
22	21	20	19	18	17
23	24	25	26	27	28
	32	31	30	29	

FIG. 8A

START FROM Ed

	4	3	2	1	
5	6	7	8	9	10
16	15	14	13	12	11
17	18	19	20	21	22
28	27	26	25	24	23
	29	30	31	32	

FIG. 8D

START FROM Eb

	32	31	30	29	
23	24	25	26	27	28
22	21	20	19	18	17
11	12	13	14	15	16
10	9	8	7	6	5
	1	2	3	4	

FIG. 8B

START FROM Ec

	29	30	31	32	
28	27	26	25	24	23
17	18	19	20	21	22
16	15	14	13	12	11
5	6	7	8	9	10
	4	3	2	1	

FIG. 8C

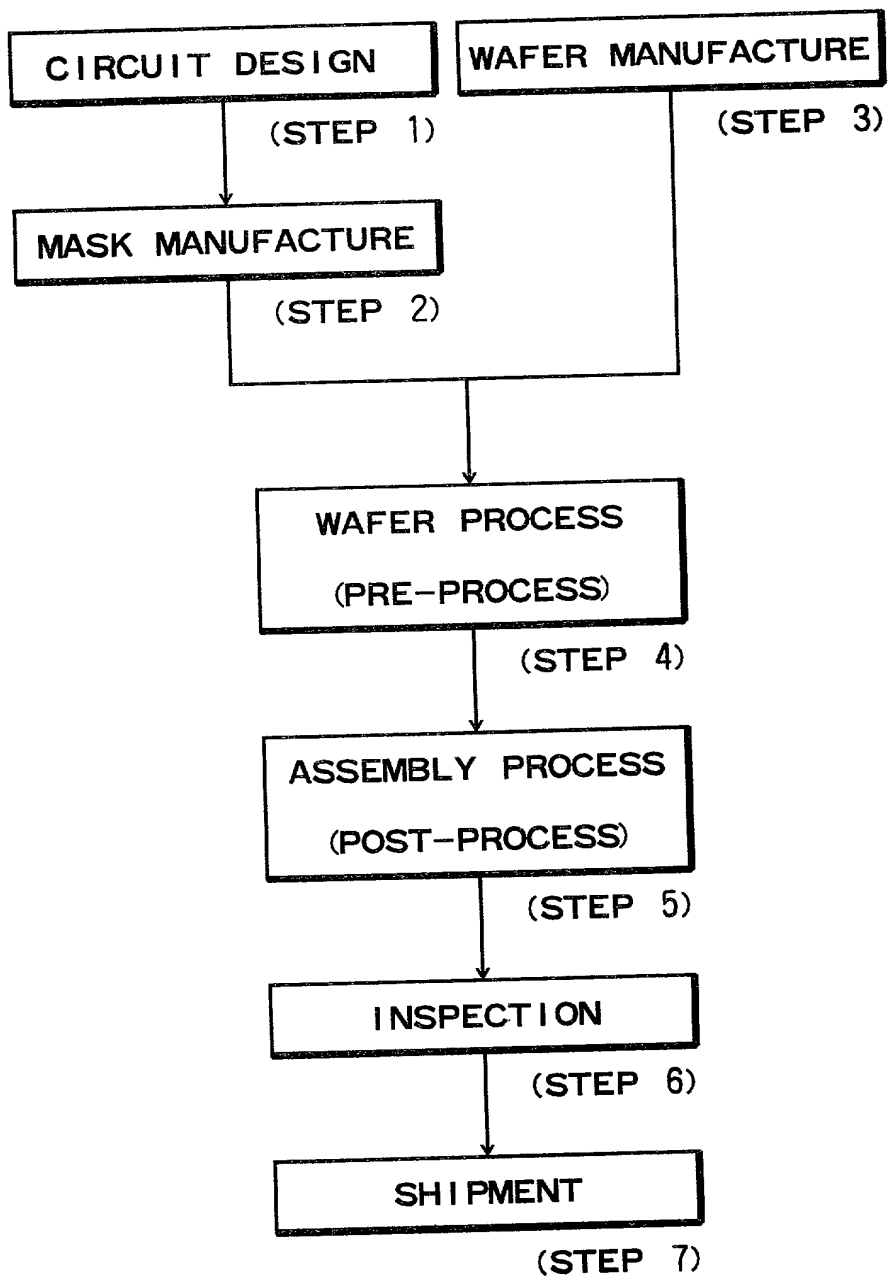


FIG. 9

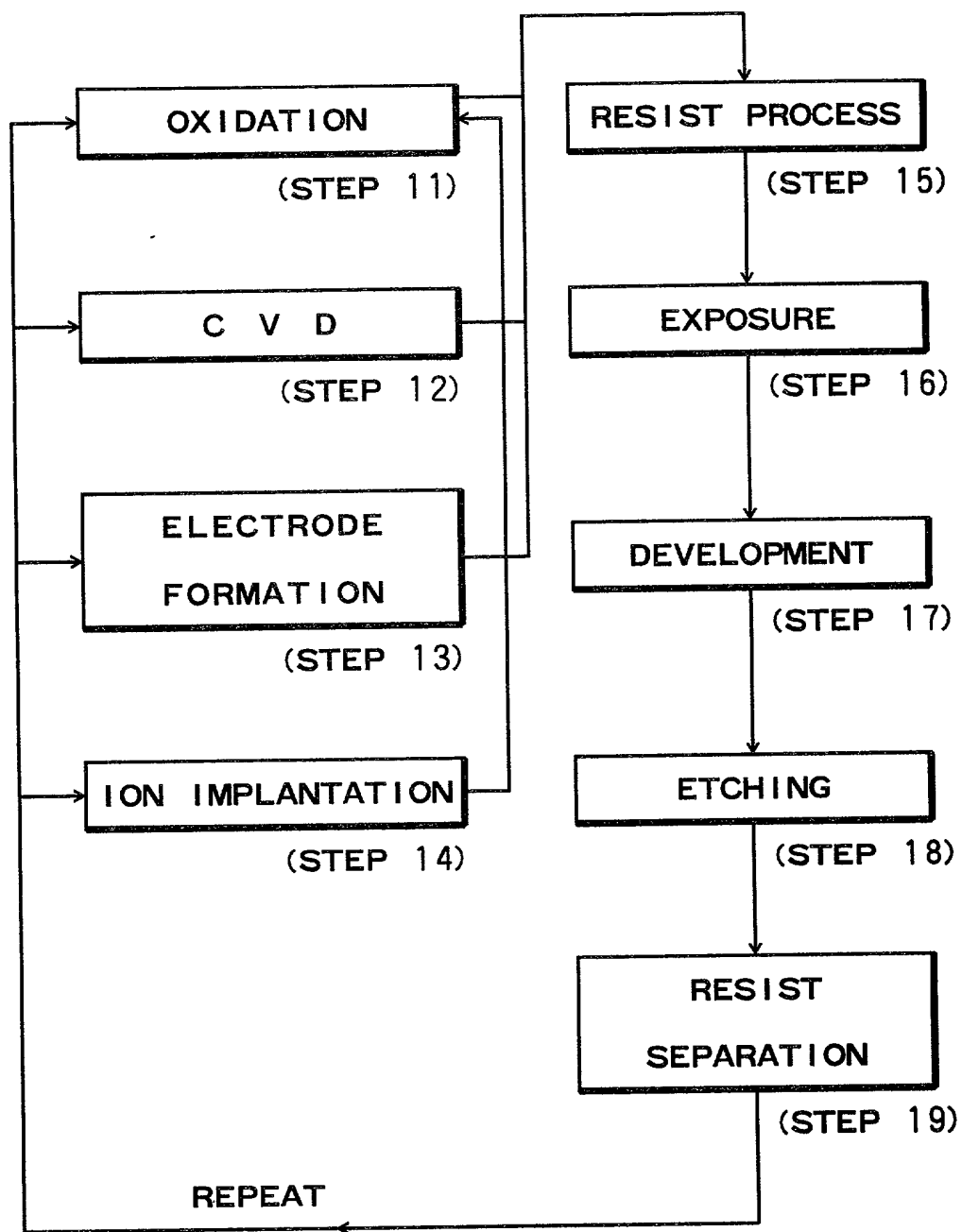


FIG. 10